

IN THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims

Claim 1.(canceled)

2.(previously presented) The method recited in claim 6 wherein in step a) providing said panoramic annular lens system comprises the step of providing a hyperboloidal lens and ellipsoidal mirror.

3.(previously presented) The method recited in claim 6 wherein in step b) providing said video camera comprises the step of providing a CCD image plane.

4.(previously presented) The method recited in claim 6 wherein in step b) providing said video camera comprises the step of providing CMOS image plane.

5.(previously presented) A method of providing a real-time panoramic video image in a rectangular format; the method comprising the steps of:

a) providing a panoramic annular lens system to capture a 360° viewed annular image;

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- b) focusing said 360° viewed annular image on a video camera image plane;
 - c) transferring a data signal output of said camera image plane to a personal computer;
 - d) utilizing said personal computer to unwrap said annular image into a substantially distortion free rectangular image at a rate of at least 30 fps; and
 - e) presenting said rectangular image on a visual display; and
- wherein step d) comprises the steps of utilizing radiometric ray tracing to first convert said annular image to a distorted unwrapped image and then to convert said distorted unwrapped image to an undistorted unwrapped image.

6.(previously presented) A method of providing a real-time panoramic video image in a rectangular format; the method comprising the steps of:

- a) providing a panoramic annular lens system to capture a 360° viewed annular image;
 - b) focusing said 360° viewed annular image on a video camera image plane;
 - c) transferring a data signal output of said camera image plane to a personal computer;
 - d) utilizing said personal computer to unwrap said annular image into a substantially distortion free rectangular image at a rate of at least 30 fps; and
 - e) presenting said rectangular image on a visual display; and
- wherein step d) comprises the step of employing a vertex-based transformation using graphics processing units of said personal computer.

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Claim 7.(canceled)

8.(previously presented) The method recited in claim 6 wherein step d) comprises the step of using at least one graphics card of said personal computer to unwrap said annular image.

Claim 9.(canceled)

10.(previously presented) The apparatus recited in claim 14 wherein said panoramic annular lens system has a hyperboloidal lens and an ellipsoidal mirror.

11.(previously presented) The apparatus recited in claim 14 wherein said video camera has a CCD imaging plane.

12.(previously presented) The apparatus recited in claim 14 wherein said video camera has a CMOS imaging plane.

13.(previously presented) An apparatus for providing a real-time panoramic video image in a rectangular format; the apparatus comprising:
a panoramic annular lens system configured for capturing 360° viewed annular image;
a video camera having an image plane for receiving said annular image and generating a corresponding data signal output;
a computer receiving said data signal output;

a graphics card and at least one software module in said computer for unwrapping said data signal output from an annular image into a substantially undistorted rectangular image at a rate of at least 30 fps; and

a visual display for displaying said rectangular image;

wherein said software module has a program for radiometric ray tracing to first convert said annular image to a distorted unwrapped image and then to convert said distorted unwrapped image to an undistorted unwrapped image.

14.(previously presented) An apparatus for providing a real-time panoramic video image in a rectangular format; the apparatus comprising:

a panoramic annular lens system configured for capturing 360° viewed annular image;

a video camera having an image plane for receiving said annular image and generating a corresponding data signal output;

a computer receiving said data signal output;

a graphics card and at least one software module in said computer for unwrapping said data signal output from an annular image into a substantially undistorted rectangular image at a rate of at least 30 fps; and

a visual display for displaying said rectangular image; and

wherein said software module has a program for vertex-based transformation for unwrapping said annular image.

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15.(previously presented) The apparatus recited in claim 14 further comprising means for capturing said data signal output; means for converting said video image from said data signal output; means for manipulating said converted video image; and means for rendering said image in a Cartesian format.

16.(currently amended) A panoramic video system having real-time distortion-free imaging; the system comprising:

a panoramic optical system having at least one optical element for viewing a 360° field of view and focusing a corresponding image on an image plane;

a video camera having a sensing element at said image plane for converting said image into a corresponding video signal;

a computer receiving said video signal and having at least one graphics processing unit employing a vertex-based transformation program for configuring a substantially distortion-free rectangular display of said image at a rate of at least 30 fps; and

a monitor for presenting said display.

17.(original) The panoramic video system of claim 16 wherein said optical system optical element comprises an annular element and said corresponding image is an annular image of said 360° field of view.

18.(original) The panoramic video system of claim 16 wherein said video camera comprises a CCD sensing element.

19.(original) The panoramic video system of claim 16 wherein said video camera comprises a CMOS sensing element.

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20.(original) The panoramic video system of claim 16 wherein said video camera sensing element has a pixel resolution of at least 1280 x 1024.

21.(original) The panoramic video system of claim 16 wherein said video camera sensing element has a pixel resolution of at least 720 x 480.

22.(original) The panoramic video system of claim 16, said computer comprising at least one graphics card for configuring said rectangular display.